



Journal of Advanced Veterinary Research

<https://advetresearch.com/index.php/avr/index>

Effect of Some Medicinal Plants as Feed Additives on Growth Performance, Blood Constituents and Carcass Characteristics of Broilers

Samar M. Amein^{1*}, Gamal M.M. Mosaad², Mohammed K. Hussein³¹Department of Animal Nutrition and Clinical Nutrition, Faculty of Veterinary Medicine, Aswan University, Egypt²Department of Animal Nutrition and Clinical Nutrition, Faculty of Veterinary Medicine, El-Minia University, Egypt³Department of Meat and Milk Hygiene, Faculty of Veterinary Medicine, Aswan University, Egypt

ARTICLE INFO

Original Research

Received:

07 October 2019

Accepted:

25 October 2019

Keywords:

Anise, Curcuma,
Fenugreek,
Growth performance

ABSTRACT

The present work aimed to study the effect of feeding broiler chicks on diets containing different levels of fenugreek, anise and curcuma seeds powder, as natural feed additive on productive performance, carcass characteristics, some blood constituents and economic feed efficiency. One hundred and forty, one-day old (Ross 38) unsexed broiler chicks were obtained from local commercial source, weighed and randomly distributed to 7 equal groups, each of 20. The birds were fed with two basal diets (starter and finisher diets). The experimental diets were as follows: basal control diet without any feed additives (G1), basal diets supplemented with 0.2 and 0.5% fenugreek (G2 and G3 respectively), basal diets supplemented with 0.3 and 0.6% anise seeds (G4 and G5 respectively), and lastly basal diets supplemented with 0.3 and 0.5% curcuma (G6 and G7 respectively). During the experiment the body weight and feed intake were measured and consequently, weight gain and feed conversion ratio were calculated. At the end of the experiment, three birds from each group were slaughtered for blood sampling and serum extraction then. Finally, economical evaluation of the diets was calculated. The results showed that, dietary inclusion of fenugreek, anise and curcuma, had significant ($P < 0.05$) improvement in the live body weight, total weight gain and feed conversion ratio, While, the feed intake was not affected by the dietary inclusion of them. Some blood constituents were affected with these additions. The relative economic feed efficiency was increased by dietary inclusion of the three additives.

J. Adv. Vet. Res. (2019), 9 (4), 170-177

Introduction

Many types of feed additives are being used in broiler rations to improve its performance. Spices are very common to be useful additives in broiler diets (Zhang *et al.*, 2009). The supplementation of spices and herbs could have many benefits to broiler's health and performance such as having antioxidative potential, antimicrobial activity (Dorman and Deans, 2000) and enhancing digestion by stimulating endogenous enzymes (Brugalli, 2003).

Fenugreek have different properties as feed additive, lowering blood sugar level, lowering blood cholesterol level, anthelmintic, antibacterial, anti-inflammatory, antipyretic, and antimicrobial (Safaa, 2007; Khan *et al.*, 2009), improved feed efficiency, reduced the feed cost and also improved body weight (Yatoo *et al.*, 2012; Qureshi *et al.*, 2015).

Anise seeds have different properties as feed additive, anti-parasitic, anti-fungal (Soliman and Badea, 2002), antipyretic (Afifi *et al.*, 1994), antioxidant (Gulcin *et al.*, 2003), an-

timicrobial (Al-Kassie, 2008), antihelminthic (Bhatti *et al.*, 1996), hypocholesterolemic (Craig, 1999) activities, antiepileptic (Janahmadi *et al.*, 2008) and muscle relaxant (Albuquerque *et al.*, 1995).

Curcumin had number of biological activities like hypolipidaemic, anti-inflammatory, antioxidant (Gandhi *et al.*, 2011), antimicrobial (Araujo and Leon, 2001), anticoagulant, antidiabetic and antiulcer (Lokova *et al.*, 2001). These compounds may also have ability to alter the structure and function of gastrointestinal tract (Viveros *et al.*, 2011); also, it is used in case of gastrointestinal and respiratory disorders (Anwarul *et al.*, 2006). Supplementation of curcumin stimulates the secretion of bile acids and increase activities of lipase, amylase and proteases, which are responsible for important roles in metabolism and accelerated digestion (Platel and Srinivasan, 2000). Curcumin also improves the liver functions and reduces the serum triglycerides, LDL cholesterol and blood glucose levels (Seo *et al.*, 2008; Gandhi *et al.*, 2011). The present study was undertaken to investigate the effect of feeding broiler chicks on diets containing different levels of fenugreek, anise and curcuma seeds powder on productive performance, carcass characteristics, some blood constituents and economic feed efficiency.

*Corresponding author: Samar M. Amein
E-mail address: samostafa1791@gmail.com

Materials and methods

Birds, accommodation and management

One hundred and forty, one-day old (Ross 38) unsexed broiler chicks were obtained from local commercial source, weighed and randomly distributed to 7 equal groups, each of 20. The experimental groups were classified according to the diet fed as follows, control group (G1): basal control diet without any feed additives, fenugreek groups (G2, G3): basal diet supplemented with fenugreek at the levels of 0.2 and 0.5% respectively, anise groups (G4, G5): basal diet supplemented with anise seed at the levels of 0.3 and 0.6% and respectively and curcuma groups (G6, G7): basal diet supplemented with curcuma at the levels of 0.3 and 0.5% respectively.

The experimental room was previously disinfected with 4% formalin and divided into compartments each of 2 m floor area bedded with a layer of chaffed wood. Chicks were vaccinated against new castle virus disease using Hitcher B, again at the age of 11 and 21 days via drinking water. Infectious bursal disease vaccine was administrated to chicks at age of 13 and 22 days by eye instillation. Chicks were vaccinated at age of 3 days against Avian Influenza virus (H5N2).

Diets and experimental design

The basal diet was formulated using [National Research](#)

[Council \(1994\)](#) recommendations. For starter period (from 0 to 14 days), it contained 23% protein, 1% calcium, 0.45% available phosphorus, 0.5% methionine and 1.1% lysine (Table 1). However, for grower-finisher period (from 15 to 42 days), it contained 21% protein, 0.9% calcium, 0.35% available phosphorus, 0.38% methionine and 1.0% lysine with 3200 Kcal ME/kg diet for the two periods (Table 2). All diets were allowed ad libitum in mash form. Live body weight and feed intake were recorded weekly throughout the experimental period.

Performance measures

The following criteria were measured during the present study

Live body weight

Live body weight (LBW) of chicks was individually measured at the beginning of the experiment and then weekly through out the experimental period. It was measured at the morning before offering feed and water. Individual body weight of each group was totaled and divided by the number of chicks to obtain the average LBW.

Body weight gain

Body weight gain (BWG) of chicks for each group was calculated by subtracting the LBW at the beginning of each week from that at the end of the same week. Individual BWG of each

Table 1. Composition and energy value of the starter experimental diets

Items	Groups						
	G1	G2	G3	G4	G5	G6	G7
Physical composition (%)							
Yellow corn	54.3	54.09	54.23	54.26	54.2	54.26	54.23
Soybean meal	36.99	36.99	36.99	36.99	36.99	36.99	36.99
Sunflower oil	4.9	4.91	4.92	4.91	4.93	4.91	4.92
Fenugreek	-	0.2	0.5	-	-	-	-
Anise seed	-	-	-	0.3	0.6	-	-
Curcuma	-	-	-	-	-	0.3	0.5
Di -Ca Po ₄	1.73	1.73	1.73	1.73	1.73	1.73	1.73
Lime stone	1.33	1.33	1.33	1.33	1.33	1.33	1.33
Methionine	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Common salt	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Premix *	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Chemical composition (%)							
Dry matter	86.27	86.23	86.64	86.25	86.21	86.25	86.64
Crude protein	23.0	23.0	23.0	23.0	23.0	23.0	23.0
Ether extract	7.56	7.57	7.98	7.57	7.59	7.57	7.98
Crude fiber	3.57	3.57	3.57	3.57	3.57	3.57	3.57
NFE	49.48	49.46	49.43	49.45	49.41	49.45	49.43
Ash	2.66	2.66	2.66	2.66	2.66	2.66	2.66
Calcium	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Av phosphorus	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Lysine	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Methionine	0.5	0.5	0.5	0.5	0.5	0.5	0.5
ME, Kcal/kg DM	3200	3200	3200	3200	3200	3200	3200

*Each 3 kg contains: Vit. A, 1200000 IU; Vit. D3, 300000 IU; Vit. E, 700 mg; Vit. k3, 500 mg; Vit. B1, 500 mg; Vit. B2, 200 mg; Vit. B6, 600 mg; Vit. B12, 3 mg; Vit. C, 450 mg; Niacin, 3000 mg; Methionine, 3000 mg; Pantothenic acid, 670 mg; Folic acid 300 mg; Biotin, 6 mg; Choline chloride, 10000 mg; Magnesium sulphate, 3000 mg; Copper sulphate, 3000 mg; Iron sulphate, 10000 mg; Zinc sulphate, 1800 mg; Cobalt sulphate, 300 mg.

Table 2. Composition and energy value of the grower finisher diets

Items	Groups						
	G1	G2	G3	G4	G5	G6	G7
Physical composition (%)							
Tallow corn	61.26	61.23	61.18	61.21	61.17	61.21	61.18
Soybean meal	31.56	31.56	31.56	31.56	31.56	31.56	31.56
Sunflower oil	3.89	3.9	3.92	3.91	3.92	3.91	3.92
Fenugreek	-	0.2	0.5	-	-	-	-
Anise seed	-	-	-	0.3	0.6	-	-
Curcuma	-	-	-	-	-	0.3	0.5
Di-Ca Po4	1.29	1.29	1.29	1.29	1.29	1.29	1.29
Lime stone	1.37	1.37	1.37	1.37	1.37	1.37	1.37
Methionine	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Common salt	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Premix*	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Chemical composition (%)							
Dry matter	86.32	86.33	86.28	86.31	68.28	86.31	68.28
Crude protein	21.0	21.0	21.0	21.0	21.0	21.0	21.0
Ether extract	6.72	6.73	6.74	6.74	6.74	6.74	6.74
Crude fiber	3.36	3.36	3.36	3.36	3.36	3.36	3.36
NFE	52.8	52.8	52.74	52.77	52.74	52.77	52.74
Ash	2.44	2.44	2.44	2.44	2.44	2.44	2.44
Calcium	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Av.phosphorus	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Lysine	1.01	1.01	1.01	1.01	1.01	1.01	1.01
Methionine	0.38	0.38	0.38	0.38	0.38	0.38	0.38
ME, Kcal/kg DM	3200	3200	3200	3200	3200	3200	3200

*Each 3 kg contains: Vit. A, 1200000 IU; Vit. D3, 300000 IU; Vit. E, 700 mg; Vit. k3, 500 mg; Vit. B1, 500 mg; Vit. B2, 200 mg; Vit. B6, 600 mg; Vit. B12, 3 mg; Vit. C, 450 mg; Niacin, 3000 mg; Methionine, 3000 mg; Pantothenic acid, 670 mg; Folic acid 300 mg; Biotin, 6 mg; Choline chloride, 10000 mg; Magnesium sulphate, 3000 mg; Copper sulphate, 3000 mg; Iron sulphate, 10000 mg; Zinc sulphate, 1800 mg; Cobalt sulphate, 300 mg.

group was totaled and divided by the number of chicks to obtain average BWG.

Feed intake

The amount of feed intake (FI) was weekly recorded in each of the different experimental groups. Average amount consumed by each bird was calculated by dividing the weekly consumed food by its respective number of bird in each group at this week.

Feed conversion ratio

Feed conversion ratio was calculated weekly as Kg feed intake /Kg gain of body weight

Hematological and blood biochemical assays

At the end of the study, three randomly selected birds of each group were slaughtered after fasting overnight.

Blood samples for serum extraction were collected in centrifuge tubes and allotted to clot at ambient temperature, centrifuged for 15 minutes at 3000 rpm. Serum samples were kept at -20 oC until further analysis. Serum samples were assayed for estimation of total protein and its fractions (albumin and globulin), triglycerides, cholesterol, uric acid, calcium and phosphorous using spectrophotometer with the commercial test kits (Spectrum, Cairo, Egypt).

The study was approved by Institutional animal care and use committee of Aswan university (ASWU, IACUC), Egypt.

Statistical analysis

The obtained results were expressed as the mean \pm SE. All data were analyzed using one way analysis of variances (ANOVA) followed by Duncan test using SPSS 20.0, statistical package for social science software (SPSS, Inc, Chicago, IL, 2001).

Results

Body weight gain and development

The obtained results (Tables 3 and 4) showed that the inclusion of fenugreek, anise and curcuma in broiler diets had no significant effect on body weight and weight gain until the third week of feeding. However, the body weight and weight gain began to increase significantly ($P < 0.05$) from the fourth week until the end of the experiment.

The results showed that fenugreek had significant ($P < 0.05$) increase in the live body weight total gain. The values of final body weight and weight gain were 2988, 2936 and 3120, 3068 g for broilers fed diets supplemented with 0.2 and 0.5% fenugreek (G 2 and G3) respectively in comparing with the values of the control group, which were 2840, 2788 for body weight and weight gain respectively, also anise supple-

Table 3. Body weight development (g/bird) of chicks in the experiment

Exp. Period		Groups					
(week)	Control group	Fenugreek groups		Anise groups		Curcuma groups	
	G1	G2	G3	G4	G5	G6	G7
0*	51.60±1.10	51.80±1.30	52.40±1.60	51.70±1.25	52.20±1.10	52.10±1.37	51.90±1.21
1	227±4.15	235±2.75	241±3.15	221±2.01	248±6.15	253±3.81	243±6.71
2	567±9.35	614±11.75	573±10.60	609±9.35	541±12.71	623±11.06	568±7.40
3	994±12.85 ^b	1022±11.40 ^{ab}	1014±19.20 ^{ab}	1079±17.35 ^a	1017±11.80 ^{ab}	1072±10.45 ^a	1005±12.15 ^{ab}
4	1629±21.62 ^b	1789±19.81 ^a	1721±21.14 ^a	1778±23.15 ^a	1667±11.75 ^{ab}	1752±19.45 ^a	1732±22.10 ^a
5	2318±32.10 ^c	2438±30.17 ^b	2515±29.18 ^a	2593±32.10 ^a	2487±35.20 ^{ab}	2573±38.11 ^a	2513±26.42 ^a
6	2840±44.60 ^c	2988±39.08 ^b	3120±32.10 ^{ab}	3290±35.80 ^a	3124±38.29 ^{ab}	3273±73.15 ^a	3115±64.20 ^{ab}

0*= initial body weight (one-day old chick)

Means within the same row with different superscripts are significantly different ($P < 0.05$)

G1: control diet GT2 and G3: diets with 0.2 and 0.5% fenugreek respectively G4 and G5: diets with 0.3 and 0.6% anise respectively G6 and G7: diets with 0.3 and 0.5% curcuma respectively.

Table 4. Weight gain (g/bird) of chicks in the experiment

Exp. Period		Groups					
(week)	Control group	Fenugreek groups		Anise groups		Curcuma groups	
	G1	G2	G3	G4	G5	G6	G7
1	175±2.15	183±3.11	189±1.65	169±1.80	196±3.20	201±3.10	191±4.33
2	340±3.99	379±4.12	332±3.75	388±3.40	293±2.90	370±3.17	325±4.10
3	427±2.78	408±6.10	441±5.21	470±8.55	476±7.11	449±3.55	437±10.20
4	635±3.75 ^b	767±13.20 ^a	707±21.10 ^{ab}	699±19.82 ^{ab}	650±18.14 ^b	680±15.42 ^{ab}	727±9.85 ^a
5	689±20.39 ^c	649±28.30 ^c	794±9.44 ^{ab}	815±27.30 ^{ab}	820±25.87 ^{ab}	821±32.27 ^{ab}	781±24.12 ^{ab}
6	522±16.30 ^b	550±5.21 ^b	605±27.90 ^{ab}	697±27.25 ^a	637±16.32 ^{ab}	700±8.62 ^a	602±30.12 ^{ab}
Total	2788±21.5 ^c	2936±36.2 ^b	3068±45.2 ^{ab}	3238±60.3 ^a	3072±18.7 ^{ab}	3221±28.1 ^a	3063±60.2 ^{ab}

*Means within the same row with different superscripts are significantly different ($P < 0.05$).

mented diets had significant increase ($P < 0.05$) in the live body weight and total gain. The values of final body weight and weight gain were 3290, 3238 and 3124, 3072 for broilers fed diets with 0.3 and 0.6% anise (G4 and G5) respectively, compared with the values of the control group, which were 2840, 2788 for body weight and weight gain respectively. Curcuma inclusion in the broilers diet had significant ($P < 0.05$) increase in body weight and total gain. The values of final body weight and weight gain were 3273, 3221 and 3115, 3063 for broilers fed diets with 0.3 and 0.5% curcuma (G6 and G7) respectively,

Feed intake

Concerning the feed intake of broilers during the experiment (Table 5), the results showed that, inclusion of fenugreek at the levels of 0.2 and 0.5% in broiler diets numerically decreased the feed intake of broilers when compared to the control one. The values of total feed intake were 4967, 5160 and 5319 g/bird for broilers fed diets with 0.2% fenugreek, 0.5% fenugreek and the control diet respectively. The inclusion of anise at the levels of 0.3 and 0.6% in broiler diets had no effect on the feed intake of broilers when compared to the control one. The values of total feed intake were 5356, 5300 and 5319 g/bird for broilers fed diets with 0.3% anise, 0.6% anise and the control diet respectively. On the other hand, the inclusion of curcuma at the levels of 0.3 and 0.5% in broiler diets had no effect on the feed intake of broilers when compared to the control one. The values of total feed intake were 5404, 5311 and 5319 g/bird for broilers fed diets with 0.3% curcuma, 0.6% curcuma and the control diet respectively.

Feed conversion ratio

Regarding the effect of dietary inclusion of fenugreek anise and curcuma at different levels on feed conversion ratio of broilers during the experiment (Table 6), the obtained results showed that their inclusion in broiler diets improved significantly ($P < 0.05$) the feed conversion ratio compared with the control one.

Blood parameters

The obtained data (Table 7) revealed that inclusion of fenugreek in the diet of broilers showed significant ($P < 0.05$) increases in the serum concentration of globulin and cholesterol, while it significantly ($P < 0.05$) decreases the serum levels of triglycerides and albumin/globulin (A/G) ratio. However, it had no significant effect on the serum levels of total protein, albumin, uric acid, calcium and phosphorus. The inclusion of anise in the diet of broilers had resulted in significant ($P < 0.05$) increases in the levels of total protein, albumin, globulin and cholesterol in the serum of broilers while, the serum levels of triglycerides and Album/Glob ratio were significantly ($P < 0.05$) decreased. However, low level (0.3%) of anise supplementation (G4) increased the serum level of albumin. The obtained results also, showed that the serum levels of uric acid, calcium and phosphorus were not significantly affected with anise inclusion in broiler diets. However, the inclusion of curcuma in the diet of broilers had resulted in significant ($P < 0.05$) increases in the serum levels of total protein, albumin, globulin and cholesterol, while, it had significant ($P < 0.05$) decreases in A/G ratio and serum triglycerides level. Curcuma had no sig-

Table 5. Feed intake (g/bird) of chicks in the experiment

	Groups						
	Control group	Fenugreek groups		Anise groups		Curcuma groups	
	G1	G2	G3	G4	G5	G6	G7
1	230	242	246	221	256	260	248
2	600	575	491	562	415	550	455
3	773	665	662	705	810	740	708
4	1168	1230	1170	1098	1248	1169	1345
5	1378	1150	1371	1450	1371	1420	1405
6	1170	1105	1220	1320	1200	1265	1150
Total	5319	4967	5160	5356	5300	5404	5311

Table 6. Feed conversion ratio of chicks in the experiment

	Groups						
	Control group	Fenugreek groups		Anise groups		Curcuma groups	
	G1	G2	G3	G4	G5	G6	G7
1	1.31	1.32	1.3	1.31	1.31	1.29	1.3
2	1.76	1.52	1.48	1.45	1.42	1.48	1.4
3	1.81	1.63	1.5	1.5	1.7	1.65	1.62
4	1.84	1.6	1.65	1.57	1.92	1.72	1.85
5	2.0	1.77	1.73	1.78	1.67	1.73	1.8
6	2.24	2.01	2.02	1.89	1.88	1.81	1.91
Mean	1.91±0.11 ^a	1.69±0.12 ^b	1.68±0.15 ^b	1.65±0.20 ^b	1.73±0.11 ^b	1.68±0.13 ^b	1.73±0.14 ^b

*Means within the same row with different superscripts are significantly different ($P < 0.05$).

Table 7. Measured blood constituents in different groups

	Groups						
	Control group	Fenugreek groups		Anise groups		Curcuma groups	
	G1	G2	G3	G4	G5	G6	G7
Total protein (g/dl)	5.95±0.21 ^b	6.32±0.14 ^{ab}	6.55±0.11 ^{ab}	7.11±0.25 ^a	6.92±0.18 ^a	6.98±0.10 ^a	7.02±0.23 ^a
Albumin (g/dl)	3.94±0.12 ^b	3.79±0.07 ^b	3.98±0.14 ^b	4.22±0.10 ^a	3.97±0.15 ^b	4.30±0.11 ^a	4.27±0.07 ^a
Globulin (g/dl)	2.01±0.21 ^b	2.53±0.08 ^a	2.60±0.25 ^a	2.89±0.10 ^a	2.95±0.18 ^a	2.68±0.04 ^a	2.75±0.11 ^a
Alb/Glob ratio	1.96±0.78 ^a	1.50±0.52 ^b	1.53±1.35 ^b	1.46±0.37 ^b	1.35±0.36 ^b	1.60±1.28 ^b	1.55±0.14 ^b
Triglycerides (mg/dl)	128.45±17.05 ^a	72.10±6.15 ^b	74.60±4.21 ^b	70.56±2.65 ^b	78.06±3.92 ^b	64.10±5.27 ^b	68.32±2.77 ^b
Cholesterol (mg/dl)	124.70±8.21 ^b	142.18±3.27 ^a	140.60±9.12 ^a	139.45±20.11 ^a	143.80±12.10 ^a	152.35±5.10 ^a	159.15±13.60 ^a
Uric acid (mg/dl)	52.10±1.50	55.25±4.08	49.20±1.65	61.40±1.79	55.10±0.56	52.35±1.13	60.70±4.82
Calcium (mg/dl)	9.77±1.04	10.25±1.12	10.32±0.23	9.80±2.28	9.40±1.05	9.56±0.34	10.35±0.91
Phosphorus (mg/dl)	6.80±0.31	5.50±0.35	6.58±0.67	6.20±1.06	6.60±2.21	7.20±0.78	6.75±0.42

*Means within the same row with different superscripts are significantly different ($P < 0.05$).

nificant effect on the serum levels of uric acid, calcium and phosphorus.

Economical evaluation

The production cost of birds in different dietary treatments is shown in Table 8. The highest total feed cost was 36.83 L.E / bird in treatment 6 and the lowest was 33.55 L.E / bird in treatment 2, while the total feed cost of the control was 35.64 L.E / bird. The difference in total feed cost was attributed to the difference in feed intake.

The obtained results in Table 8, showed that the net revenue in groups fed fenugreek was higher in G3 (34.66 L.E / bird) than in G2 (32.95 L.E / bird), while the net revenue in con-

trol group (G1) was 27.11 L.E / bird. The net revenue in groups fed anise was higher in G4 (37.99 L.E / bird) than in G5 (33.13 L.E / bird). While, the net revenue in groups fed curcuma was higher in G6 (36.67 L.E / bird) than in G7 (33.11 L.E / bird).

Results from this study indicated that the relative economic feed efficiency was increased in all treated treatments in comparison with the control group. The values were 128, 129, 135, 120, 132 and 119 for G2, G3, G4, G5, G6 and G7, respectively (Table 8).

Discussion

The supplementation of spices and herbs could have many benefits to broiler's health and performance such as

having anti-oxidative potential, antimicrobial activity (Dorman and Deans, 2000) and enhancing digestion by stimulating endogenous enzymes (Brugalli, 2003).

The results of the present study clearly showed that the addition of fenugreek, anise or curcuma in broilers feed had no significant effect on the body weight and weight gain until the third week of feeding. However, the body weight and weight gain began to increase significantly ($P < 0.05$) from the fourth week until the end of the experiment. The positive effect of fenugreek, anise or curcuma on the live body weight and total gain may be attributed to the fact that fenugreek contains essential fatty acids and high quality proteins (Murray et al., 1991) as well as fenugreek has stimulating effect on the villus height of digestive system of broilers (Hernandez et al., 2004; Hind et al., 2013; Mamoun et al., 2014; Mahmood et al., 2015). Anise seeds stimulate digestion (Cabuk et al., 2003), particularly the digestion of protein, fats and cellulose (Jamroz and Kamel, 2002). In addition, curcuma had the ability to stimulate digestive enzymes and pancreatic lipase (Platel and Srinivasan, 2000; Rajput et al., 2013).

The obtained results agreed with the results of Elbushra (2012) and Awadein et al. (2010), who reported significant ($P < 0.05$) increases in the body weight and body weight gain of broilers fed 0.5% fenugreek supplemented diets. Eltazi (2014) and Al-Kassie (2008) indicated that there was a significant ($P < 0.05$) increase in the body weight gain of broilers fed 1% anise supplemented diets. Furthermore, Foldesioval et al. (2015) showed that the curcuma supplementation in the rabbit feed at level 15 and 20 g/kg had a significant ($P < 0.05$) increase in the weight gain. These results are disagreed with that reported by Duru et al. (2013), who reported that, the live body weight and weight gain were significantly ($P < 0.05$) decreased by supplementation of fenugreek at level 5 g/kg and with that mentioned by Yazdi et al. (2014), who observed that different levels (1, 5 and 10 g) of anise seed decrease the weight gain but not significantly.

In the present study, feed intake was numerically decreased with fenugreek supplementation, while, anise and curcuma had no significant effect on the feed intake. The obtained results are in harmony with the results of Duru et al. (2013), who recorded that dietary inclusion of fenugreek at level 5 g /kg feed significantly ($P < 0.05$) decreased the feed intake in broiler chickens. Also, Soltan et al. (2008) reported that anise powder at different levels (0.25, 0.5, 0.75, 1 and 1.5%) of the feed had no significant effect on the feed intake. In addition, Mondal et al. (2015) and Ahlawat et al. (2018) reported that supplementation of curcuma at level 0.5 and 1% of the feed had no significant effect on the feed consumption. On

the other hand, results from this study disagreed with Abd AL-Jaleel (2012) and Choudhury et al. (2017), who reported that the feed consumption was significantly ($P < 0.05$) increased in broilers fed 0.5% curcuma supplemented diets.

The feed conversion ratio was significantly improved with supplementation of different levels of fenugreek, anise or curcuma. The positive effect on feed conversion ratio may be due to the development of morphological changes of gastrointestinal tissues of the chicks gut, which can be induced by differences in gut load of microbial content including their metabolites (Alloui et al., 2012; Amal et al., 2013; Mukhtar et al., 2013; Weerasingha and Atapattu, 2013) or stimulation of bird digestive system, particularly protein, fats and cellulose digestion (Cabuk et al., 2003). The obtained results are in accordance with the earlier findings of Elbushra (2012) and Awadein et al. (2010), who declared that dietary supplementation of fenugreek in broiler diets at level of 0.5% of the feed improved the feed conversion ratio. In addition, Yazdi et al. (2014) and Eltazi (2014) reported that feeding of anise supplemented diets at 1% of the feed significantly ($P < 0.05$) improved the feed conversion ratio in broilers diets. Moreover, Ahlawat et al. (2018) and Choudhury et al. (2017) reported that feed conversion ratio was significantly ($P < 0.05$) improved in broiler diets supplemented with 0.5% curcuma. Results from the current study disagreed with Kumar and Shukla (2017) and Rahmani et al. (2017), who reported that curcuma at different levels had no significant effect on the feed conversion ratio.

The beneficial effects of anise on the cellular and biochemical traits of blood may result from the improvement of biological and metabolic processes as well as from the optimized utilization of nutrients in the digestive system (Al-Shammari et al., 2017). Also, the increases in the levels of total protein, albumin and globulin may confirm that anise may enhance the resistance of the chickens against different stress factors (Soltan et al., 2008). The obtained results showed that the serum levels of uric acid, calcium and phosphorus were not significantly affected with anise inclusion in broiler diets. The results are in agreement with that of Al-Shammari et al. (2017), who noted that supplementation broiler with anise at levels 500, 700 and 1000 mg/l, had significant ($P < 0.05$) increase in the levels of albumin, globulin and total protein in the serum of broilers. The inclusion of curcuma in the diet of broilers had resulted in significant ($P < 0.05$) increases in the serum levels of total protein, albumin and globulin. Elevated total protein level suggested better ability of the hepatocytes of the treated group to synthesize protein. Also, significantly high serum globulin level suggested that birds of treated group had potential for better humoral immune status (Kumari et al., 2007).

Table 8. Economical evaluation of the different experimental diets

	Groups						
	Control group	Fenugreek groups		Anise groups		Curcuma groups	
	G1	G2	G3	G4	G5	G6	G7
Av. feed intake (kg/bird)	5.32	4.97	5.16	5.36	5.3	5.4	5.31
Price/kg feed (L.E)	6.7	6.75	6.8	6.83	6.91	6.82	6.9
Total feed cost (L.E)	35.64	33.55	35.09	36.61	36.62	36.83	36.64
Total production cost (L.E)	43.89	41.8	43.34	44.86	44.87	45.08	44.89
Body weight (kg/bird)	2.84	2.99	3.12	3.29	3.12	3.27	3.12
Price/kg body weight (L.E)	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Total revenue (L.E)	71.0	74.75	78.0	82.25	78.0	81.75	.0
Net revenue (L.E)	27.11	32.95	34.66	37.39	33.13	36.67	33.11
Economic feed efficiency %	61.77	78.83	79.97	83.35	73.84	81.34	73.76
Relative economic feed efficiency	100.0	128.0	129.0	135.0	120.0	132.0	119.0

The obtained results are in line with Hussein (2013), who reported that serum triglycerides level was significantly ($P < 0.05$) decreased with 7 g curcuma fed diet. On the other hand, the present study disagreed with that of Mamoun et al. (2014), who investigated that feeding fenugreek in broiler diets at different levels (1, 2 and 3%) had significant ($P < 0.05$) increases in the serum levels of triglycerides and phosphorus but, significantly decreased the serum levels of albumin, total protein, calcium and cholesterol.

The obtained results indicated that the relative economic feed efficiency was increased in all treated treatments in comparison with the control group.

Conclusion

Inclusion of different levels of fenugreek, anise and curcuma seeds powder in broilers feeding had a significant improvement in the live body weight, total weight gain and feed conversion ratio. While, the feed intake was not affected by the dietary inclusion of them. Some blood constituents were affected with these additions. The relative economic feed efficiency was increased by dietary inclusion of the three additives.

Acknowledgement

Financial support of Aswan University (Egypt) for this study is appreciated.

Conflict of interest

Authors declared that no conflict of interest exist

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